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Issue Number 10

January 1985

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# Pragma's PRODUCT PROFILES

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## Beyond The Power Of The Pick System

- Sometimes a lot of programming effort has
- to be expended to coerce a Pick system into doing what would seem to be a simple task
  - for a computer. This issue's front cover illustrates our own favorite example of an
  - application on a Pick machine that demands more than what Pick can easily provide. The
  - cover shows a name and address "browser" (called FIND) which we use to search
  - subscriber lists.

- A Pick computer at Semaphore maintains
- various subscriber files, some containing over ten thousand names and addresses. Because
  - of subscriber additions or changes, the files need to be searched and updated dozens of
  - times, and sometimes hundreds of times, every day. Searches by last name, company
  - name, or ZIP code are constantly required.

- Years ago, when our files were fairly small
- and transactions were relatively infrequent, the techniques we used were typical for a
  - Pick site. We would periodically print the file (sorted three different ways, for each of
  - the three different types of searches), and use the listing to find file items. Once enough
  - changes had accumulated, the file would be sorted and printed again. But that approach
  - was soon abandoned, because sorting and printing took too much time and paper, and
  - because it was easy to fail to find a name, since recent updates were never reflected in
  - any listing made before the edits occurred. Also, we found that operators needed to
  - browse. That is, they would locate a name or ZIP code, and then need to inspect some of
  - the entries around that item (say, the ten preceding names, or the five next ZIP codes).
  - Browsing is an especially powerful tool for noticing duplicates, locating misspellings,
  - finding complete data when only a fragment is known, and so on.

- It quickly became obvious that we needed online searching with CRTs, along multiple
- paths and in any direction. Unfortunately, that didn't mean simply using the display screen instead of paper for our output lists,

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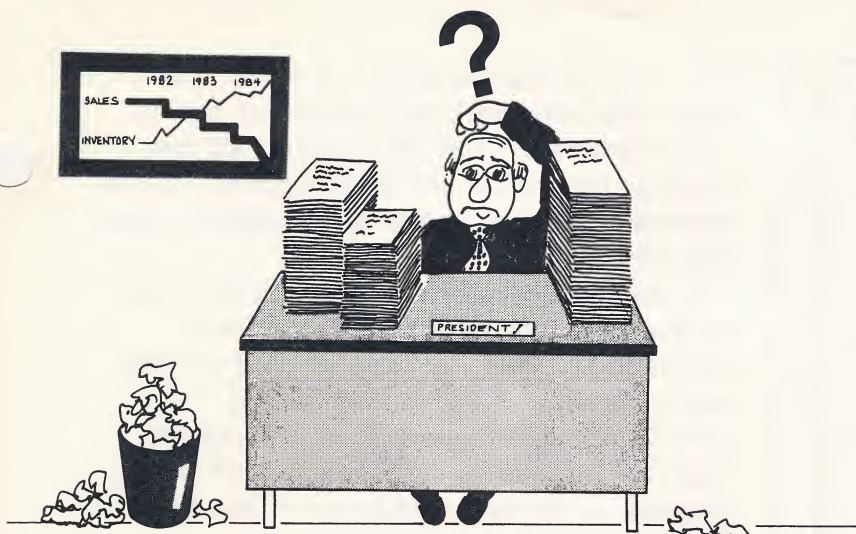
since sorting and searching would still take too long, and CRT output on a Pick system is a one way street: once the data scrolls by, you can't back up and look at it again without repeating the search and sort.

We eventually created the FIND program and some associated support software in order to meet our requirements. FIND displays a subscriber list of any size in ZIP code, company name, or subscriber name order. The operator can select which order at any time, and the display is always instantly updated. The front cover illustration shows a portion of a typical FIND display, which includes columns of personal names, unique ID numbers, company names, addresses, and ZIP codes. The example happens to be in ZIP order. The arrows on the top row remind the operator which sort is currently displayed. Besides being accessible by a unique numeric key, any row containing a name or ZIP code beginning with any fragment of one to five characters can be immediately displayed, and an arbitrary quantity of sorted entries before and after the selected item are also shown at all times. The list can be instantly scrolled up or down, in various increments, allowing quick and easy browsing.

A separate program called GET provides a formatted screen for creating or editing name and address items. However, GET is designed to work in conjunction with FIND, so that all edits to the file will be immediately reflected in the FIND display. For example, if an item's ZIP code is changed, the entry is immediately deleted from its old position in the FIND list and reappears in its new position. The result is a Pick system able to instantly sort and browse up and down through a displayed list of any number of items, all continuously maintained in order. It almost has to be seen to be believed.

To make it work, we decided to store the file as a doubly-linked list, using three pairs of pointers in every entry. Each pointer pair indicates the previous and next adjoining items to display, depending on which ordering is in effect. One pair indicates the items with the previous and next ZIP codes, one pair ties personal names, and one pair handles company names. A separate cross-reference





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file provides the capability of locating an item using any starting fragment of one to five characters. The file contains all the possible fragments, and each fragment has an associated pointer to the corresponding name and address entry.

A doubly-linked list is simple to traverse, so the FIND program itself is not very complicated. The 170 lines of code in FIND are primarily concerned with screen formatting and dispatching on the various operator commands. The separate GET program is the real workhorse of the system. Besides providing a formatted screen for creating, changing, or deleting any name and address item, GET must also correctly maintain all the links in the file, which under certain circumstances can involve very complicated logic. For example, any time an item is deleted, not only do its previous and next neighbors have to be linked together to effect the deletion from the doubly-linked list, but all fragments in the cross-reference file that refer to the deleted item must also be deleted or redirected to the next applicable item. And that's just for deletions, which are relatively simple. Cross-references and links also have to be adjusted after any name or address changes.

Maintaining sort order is also trickier than it looks. For example, when displayed by ZIP, rows are secondarily sorted by address, then company, then last name, then numeric ID! (Similarly, the file is also sorted by last name and ID when listed by company, and the name sort is also secondarily sorted by ID.) That means GET might have to change an item's position in a display sorted by ZIP even if the street address only, and not the ZIP, changed.

Inserting a new item as quickly as possible is an especially tough problem. If the cross-reference file happens to already index some existing item with the same ZIP, then that's a good place to start searching for the correct insertion point for the new item. But what if the ZIP isn't already in the list? Then the search has to start from some nearby location. (Don't forget that personal and company names must also be inserted into the linked list every time they're created or changed.) Fortunately, our GET algorithms



for handling a first-time insertion keep the wait time to a minimum, typically just a few seconds at most.

Of the 240 lines of code in GET, about 85 deal with the mundane task of formatted screen editing. A separate 150-line subroutine provides table-driven editing functions, similar to the input processor described in the February 1984 *Pragma*. The remaining code in GET performs all the linked list and cross-reference file handling.

Note that by relying on B-trees or similar data structuring and access mechanisms, the Pick operating system could, in theory, be extended to automatically maintain file items sorted along multiple paths, and changed to offer a READPREVIOUS capability to go along with READNEXT, but without requiring a sort to finish, and without impacting any of the existing software already developed for Pick. Then programmers wouldn't have to spend

hours writing complicated systems like GET. We've found a number of computer systems that already offer data access techniques better than Pick, but (except for IBM's System/38) they all appear cumbersome, and seem to consist of software tacked onto an operating system, instead of integrated into it. ☐

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